

NEW, CONTINUATION, DIVISIONAL OR
CONTINUATION-IN-PART APPLICATION
UNDER 37 C.F.R. §1.53(b)

Attorney Docket No. 9329-001COI
Express Mail Label No. EI778760343US
Date

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Hon. Commissioner of Patents and Trademarks
Washington, D. C. 20231

Sir:

Transmitted herewith for filing under 37 C.F.R. §1.53(b) is a patent application for **ELECTRONIC STILL VIDEO CAMERA WITH DIRECT PERSONAL COMPUTER (PC) COMPATIBLE DIGITAL FORMAT OUTPUT**

identified by: ☒ First named inventor Marc K. Roberts et al.
or ☐ Attorney Docket No. (see above)

1. Type of Application

☐ This application is a new (non-continuing) application.

☒ This application is a ☒ continuation / ☐ divisional / ☐ continuation-in-part of prior application No. **08/712,493**. Amend the specification by inserting before the first line the sentence:

--This is a continuation of United States patent application No. 08/712,493, filed September 11, 1996, which is a continuation of United States patent application No. 08/098,787, filed July 29, 1993, now U.S. Patent No. 5,576,757, which is a continuation of United States Patent Application No. 07/878,603, filed May 5, 1992, now abandoned, which is a continuation of United States patent application no. 07/615,848, filed November 20, 1990 and now U.S. Patent No. 5,138,459.--

☒ The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied, is considered part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

If for some reason applicant has not requested a sufficient extension of time in the parent application, and/or has not paid a sufficient fee for any necessary response in the parent application and/or for the extension of time necessary to prevent the abandonment of the parent application prior to the filing of this application, please consider this as a Request for an Extension for the required time period and/or authorization to charge our Deposit Account No. 08-0750 for any fee that may be due. THIS FORM IS BEING FILED IN TRIPLICATE: one copy for this application; one copy for use in connection with the Deposit Account (if applicable); and one copy for the above-mentioned parent application (if any extension of time is necessary).

2. Contents of Application

a. Specification of 27 pages;

- ☐ A microfiche computer program (Appendix);
☐ A nucleotide and/or amino acid sequence submission;

☐ Because the enclosed application is in a non-English language, a verified English translation ☐ is enclosed ☐ will be filed.

Attorney Docket No. 9329-001COI

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Date _____

☒ Cancel original claims **2-20** of the prior application before calculating the filing fee.
(At least one original independent claim must be retained for filing date purposes.)

b. ☒ Drawings on **11** sheets;

c. ☒ A signed Oath/Declaration ☒ is enclosed / ☐ will be filed in accordance with
37 C.F.R. §1.53(f).

The enclosed Oath/Declaration is ☐ newly executed / ☒ a copy from a prior application
under 37 C.F.R. §1.63(d) / ☐ accompanied by a statement requesting the deletion of
person(s) not inventors in the continuing application.

d. **Fees**

FILING FEE	Number	Number		Basic Fee
CALCULATION	Filed	Extra	Rate	\$760.00
Total Claims	1 - 20 =	-0- x	\$18.00 =	-0-
Independent Claims	1 - 3 =	-0- x	\$78.00 =	-0-
Multiple Dependent Claim(s) Used			\$260.00 =	
FILING FEE - NON-SMALL ENTITY				
FILING FEE - SMALL ENTITY: Reduction by 1/2				
<input type="checkbox"/> Verified Statement under 37 C.F.R. §1.27 is enclosed.				
<input type="checkbox"/> Verified Statement filed in prior application.				
Assignment Recordal Fee (\$40.00)				
37 C.F.R. §1.17(k) Fee (non-English application)				
TOTAL				\$760.00

☒ A check is enclosed to cover the calculated fees. The Commissioner is hereby
authorized to charge any additional fees that may be required, or credit any
overpayment, to Deposit Account No. 08-0750. A duplicate copy of this document is
enclosed.

☐ The calculated fees will be paid within the time allotted for completion of the filing
requirements.

☐ The calculated fees are to be charged to Deposit Account No. 08-0750. The Commissioner
is hereby authorized to charge any additional fees that may be required, or credit any
overpayment, to said Deposit Account. A duplicate copy of this document is enclosed.

3. **Priority Information**

☐ **Foreign Priority:** Priority based on _____ Application No. _____, filed _____, is
claimed.

Attorney Docket No 9329-001COI

Express Mail Label No. E1778760343US

Date _____

☐ A copy of the above referenced priority document ☐ is enclosed / ☐ will be filed in due course, pursuant to 35 U.S.C. §119(a)-(d).

☐ **Provisional Application Priority:** Priority based on United States Provisional Application No. _____, filed _____, is claimed under 35 U.S.C. §119(e).

4. **Other Submissions**

☒ A Preliminary Amendment is enclosed.

☐ An Information Disclosure Statement, _____ sheets of PTO Form 1449, and _____ patent(s)/publications/documents are enclosed.

☒ A power of attorney

☐ is submitted ☐ with the new Oath/Declaration.

☒ is of record in the prior application and ☒ is in the original papers / ☐ a copy is enclosed.

☒ An Assignment of the invention

☐ is enclosed with a cover sheet pursuant to 37 C.F.R. §§3.11, 3.28 and 3.31.

☒ is of record in a prior application. The assignment is to **St. Clair Intellectual Property Consultants, Inc.**, and is recorded at Reel **7803**, Frame(s) **0944**.

☐ An Establishment of Assignee's Right To Prosecute Application Under 37 C.F.R. §3.73(b), and Power Of Attorney is enclosed.

☒ An Express Mailing Certificate is enclosed.

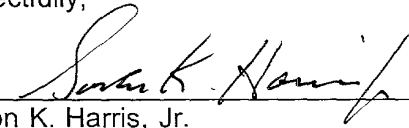
☒ Other: check covering additional claim fee.

Attention is directed to the fact that the correspondence address for this application is:

Harness, Dickey & Pierce, P.L.C.
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(248) 641-1600.

Respectfully,

Date February 19, 1999
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Gordon K. Harris, Jr.
Reg. No. 28,615

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of Marc K. Roberts et al.

Newly filed Continuation of U.S. Serial No. 08/712,493
Filed September 11, 1996

Group Art Unit: 2712

Examiner: T. Ho
For: ELECTRONIC STILL VIDEO CAMERA
WITH DIRECT PERSONAL
COMPUTER (PC) COMPATIBLE
DIGITAL FORMAT OUTPUT

**PRELIMINARY
AMENDMENT**

Hon. Commissioner of Patents and Trademarks,
Washington, D.C. 20231

SIR:

Prior to substantive examination of the captioned continuation application filed pursuant to 37 C.F.R. §1.53(b), please amend the application, as follows:

IN THE CLAIMS:

Please cancel Claim 1.

Please add the following new claims:

21. (NEW) A digital camera memory system comprising:

a removable digital memory element for storing digitized image data,

a digital control unit for checking the memory element to determine if the memory element has been initialized,

a display for giving an indication of the results of the checking to a user of the camera, and

a user control for instructing the digital control unit to perform initialization of the memory element.

22. (NEW) A process for using a removable memory element in a digital camera comprising:

checking the memory element to determine whether it has been initialized,
providing an indication to a user of the camera of results of the checking, and
initializing the memory element in response to a user command.

23. (NEW) A digital camera comprising:

an operator-selectable control switch,
means for capturing and digitizing image data,
a memory element for storing digitized image data, and
a programmable control unit including:
means for initiating and performing a self-test diagnostic routine upon power-up of the camera; the routine including
checking status information concerning the operator-selectable switch,
checking for presence of the memory element,
checking for initialization of the memory element,
checking a capacity of the memory element, and
determining an available number of image frames storable on the memory element based upon the switch status information and the memory capacity checking.

24. (NEW) The digital camera of claim 23 further comprising:

means for displaying the available number of image frames storable on the memory element.

25. (NEW) The digital camera of claim 23 wherein the memory element is removably coupled to the camera and wherein the programmable control unit further comprises means for initiating and performing a self-test diagnostic routine for checking for initialization and capacity of the memory element upon coupling of the memory element to the camera.

26. (NEW) The digital camera of claim 23 wherein the programmable control unit further includes means for periodically repeating the checking of the switch status information during use of the camera.

27. (NEW) The digital camera of claim 23 wherein the operator-selectable control switch is capable of assuming a plurality of settings including:

- a color/black and white selection setting,
- a resolution mode selection setting, and
- a compression mode selection setting.

28. (NEW) In a digital camera having an operator-selectable control switch, an electric power supply, means for capturing and digitizing image data, a memory element removably coupled to the camera and a programmable control unit, a method for performing, via the control unit, diagnostic tests on the camera comprising the steps of:

- sensing power-up of the camera,
- checking an output level of the power supply,
- performing diagnostic tests on the control unit,
- checking status information concerning the operator-selectable switch,
- checking for the presence of the removable memory element,
- checking for initialization of the removable memory element,
- checking a capacity of the removable memory element, and
- determining an available number of image frames storable on the memory element

based upon the switch status information and the memory capacity checking.

29. (NEW) The method of claim 28 wherein the steps are periodically repeated during use of the camera.

30. (NEW) The method of claim 28 wherein the steps of checking for initialization, checking a capacity and determining an available number of image frames are performed whenever a removable memory element is coupled to the camera.

32. (NEW) An electronic camera comprising:

an image capture unit for generating a digital data representation of a captured light image;

a storage device for storing said digital data representation as a frame of image data in the form of an image data file having a variable length, said storage device having stored therein data regarding unused storage capacity of the storage device;

a storage device input/output interface for recording said image data file in said storage device and for reading said data regarding said unused storage capacity;

a mode selection switch having settings which change the length of an image data file to be recorded in said storage device depending on the mode selected;

a digital control unit for examining the unused storage capacity data and the mode selection switch setting to determine the remaining number of frames of image data that can be stored in the unused storage capacity of the storage device based on the variable length of the image data files for said remaining frames as determined by the mode selection switch setting, such examination occurring periodically after the recording of an image data file in the storage device; and

a user display for displaying an error code whenever said periodic examination of the digital control unit determines that said remaining area of the storage device is insufficient for recording an image data file of the variable length determined by the mode selection switch setting.

33. (NEW) The camera of claim 32 wherein said user display additionally displays a number of available image storage frames available at a current mode switch setting.

34. (NEW) An electronic camera comprising:

an image capture unit for generating a digital data representation of a captured light image;

a storage device for storing said digital data representation as a frame of image data in the form of an image data file having a variable length, said storage device having stored therein data regarding unused storage capacity of the storage device;

a storage device input/output interface for recording said image data file in said storage device and for reading said data regarding said unused storage capacity;

a mode selection switch having settings which change the length of an image data file to be recorded in said storage device depending on the mode selected;

a digital control unit for examining the unused storage capacity data and the mode selection switch setting to determine the remaining number of frames of image data that can be stored in the unused storage capacity of the storage device based on the variable length of the image data files for said remaining frames as determined by the mode selection switch setting, such examination occurring periodically after the recording of an image data file in the storage device; and

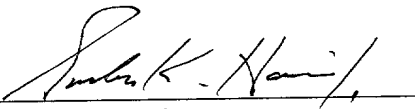
a user display for displaying a number of image frames remaining in the storage device assuming no change to a current mode selection switch setting.

Respectfully submitted,

Marc K. Roberts et al.

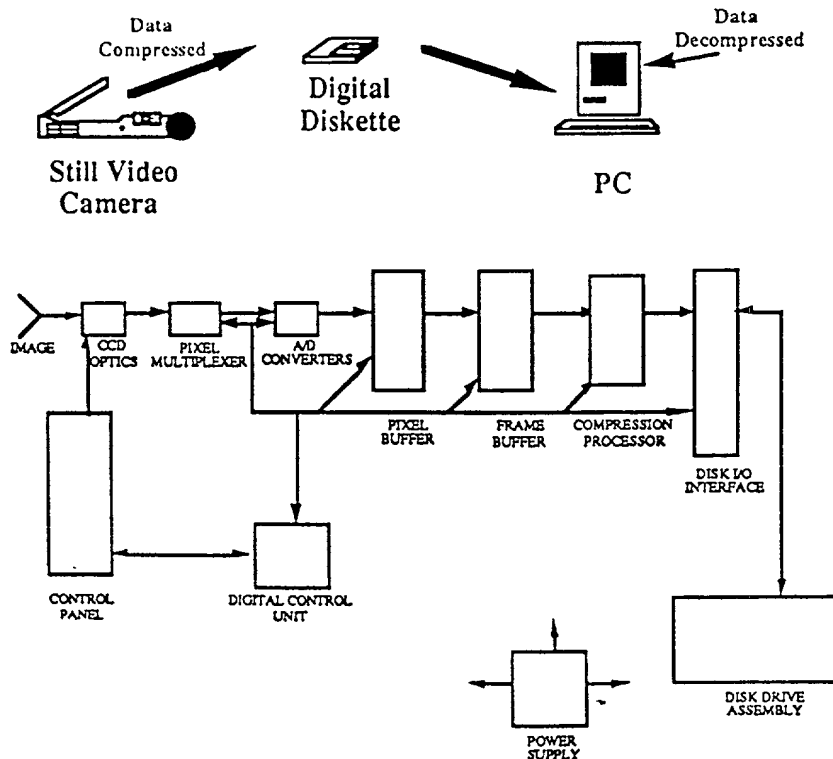
Date: February 19, 1999

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By: 
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ABSTRACT

An electronic still camera comprising a lens, shutter, and exposure control system, a focus and range control circuit, a solid state imaging device incorporating a Charge Coupled Device (CCD) through which an image is focused, a digital control unit through which timing and control of an image for electronic processing is accomplished, an Analog-to-Digital (A/D) converter circuit to convert the analog picture signals into their digital equivalents, a pixel buffer for collecting a complete row of an image's digital equivalent, a frame buffer for collecting all rows of an image's digital equivalent, and a selectively adjustable digital image compression and decompression algorithm that compresses the size of a digital image and selectively formats the compressed digital image to a compatible format for either the IBM Personal Computer and related architectures or the Apple Macintosh PC architecture as selected by the operator so that the digital image can be directly read into most word processing, desktop publishing, and data base software packages including means for executing the appropriate selected decompression algorithm; and a memory input/output interface that provides both temporary storage of the digital image and controls the transmission and interface with a standard Personal Computer (PC) memory storage device such as a digital diskette. The digital diskette is removably inserted into the housing of the camera prior to use in recording digital image data.



ELECTRONIC STILL VIDEO CAMERA WITH DIRECT PERSONAL COMPUTER (PC) COMPATIBLE DIGITAL FORMAT OUTPUT BACKGROUND OF THE INVENTION

1. Field of the Invention

5 This invention generally relates to an electronic still video camera and in particular to an improved electronic still camera which converts a still picture of an object or scene into an operator selectable compressed digital signal format for storage utilizing a compression/decompression algorithm, such as the Joint Photographic Experts Group (JPEG) algorithm standard for example, formatted
10 into Personal Computer (PC) compatible format retaining the images' color information, and stored on a PC compatible memory diskette. For example, the diskette can be a three and a half (3 1/2) inch digital diskette. The digital diskette is removeable from the electronic camera for direct insertion into a PC which contains the previously loaded corresponding decompression algorithm whereby the digital
15 image is in a format compatible for immediate use with word processing, desk top publishing, data base, and multi-media applications.

2. Description of the Prior Art

Fig.1 is a schematic block diagram showing structure of a conventional prior art electronic still camera system, in which a CCD image sensor element 1a
20 converts a still image of an object into an analog color video signal when the shutter control circuitry 2a is activated. The output color video signal of the image sensor element is then routed to the signal processing subsystem 3a where the signal is converted to National Television System Committee (NTSC) or other composite video formats (such as the European video standard Phase Alternating Line-PAL)
25 and logged in analog format onto a mass memory storage device such as an analog video floppy disk, Electrically Erasable Programmable Read Only Memory (EEPROM), analog audio cassette, bubble memory, or other storage device 5a. Power is supplied by a rechargeable / removeable battery system 4a.

An electronic camera that converts an image into electronic image signals
30 and transferred to a memory storage device is disclosed in the following: U.S. Patent No. 4,131,919; U.S. Patent No. 4,456,931; U.S. Patent No. 4,758,883; U.S. Patent No. 4,803,554; and U.S. Patent No. 4,837, 628.

Conventional prior art electronic still cameras, for example of the types disclosed in the aforementioned references, produce an electronic signal
35 corresponding to a desired image in analog format such as the National Television System Committee (NTSC) or similar on magnetic or electronic storage media for either permanent or temporary storage to facilitate viewing on a television or video monitor. With the current state of the art, it is expensive and time consuming to

convert the analog image equivalent to a digital format for direct utilization with PC software applications. Currently, to convert an image captured on an electronic still camera to a PC compatible format one must convert the signal back to either a composite-NTSC or RGB video signal and use a conversion device such as a "frame grabber" (a digital circuit board installed into PCs that convert video images into PC compatible formats) of the type sold commercially by Aapps Corporation, Orange Micro, RasterOps, and others or convert the image to a hard-copy print (a photograph) and utilize an electronic "scanner", a piece of equipment that connects to a PC, which converts an image into a digital format. The later technique is employed extensively within the desktop publishing industry.

SUMMARY OF THE INVENTION

It is the object of this invention to provide an improved electronic still camera with operator selectable picture compression in one of a plurality of operator selectable digital data formats recordable on a standard removeable magnetic diskette common to personal computers.

It is a further object of this invention to provide an improved electronic still camera that provides digital image files for immediate and direct incorporation into popular word processing, desktop publishing, and other software programs on PCs.

It is another object of this invention is to provide an improved electronic still camera that, under user selection, can record and store still images selectively compressed in a directly insertable digital memory storage device into a PC in either color or black and white formats thus facilitating storage of a large number of images with the signal flag indicating the degree of compression selected by the operator as well as the color/black and white mode selection being stored as digital values on the digital memory storage device with each image frame.

An additional object of this invention to provide an electronic still camera device that can rapidly capture a series of images automatically as well as singularly. Also, this camera provides multiple outputs in both video format for monitor and display of images and digital formats to facilitate data transmission, additional processing, or storage to a variety of storage media.

It is still another object of this invention is to provide a more efficient electronic still camera that can take a still picture with operator selectable high, medium, or low resolution in either color or black and white by electronic shutter and exposure control by utilizing a variety of electro-optical sensors including Charge Coupled Devices (CCD), Infrared (IR), and Ultra Violet (UV) which can be directly or remotely controlled by analog, digital, or radio frequency (RF) control signals.

A further object of this invention is to provide a programmable video picture translator device for efficiently converting electronic still images in analog composite video format into digital data format readable by a PC. This translator device also provides additional video inputs and outputs for capturing video images, monitoring video images on monitors and displays, and can transmit either compressed or unprocessed digital image data through a variety of output I/O channels in various formats such as serial, parallel, etc. Also, this invention can incorporate sound/voice with images thru additional interface circuitry and audio digitizers.

Finally, it is the object of this invention to provide an electronic still camera that is efficient in design and permits extended periods of portable operation and which provides the user with operational status through the use of continuous internal self-test software routines and operator displays.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic block diagram of a conventional prior art electronic still camera .

FIG. 2 is a schematic block diagram of the overall structure of an electronic still camera embodying the present invention.

FIG. 2A is an illustration showing one embodiment of an audio data file, data format flag, compression level, and color/black and white mode selection values stored on a digital memory diskette storage device.

FIG. 3 is a flowchart showing the power-up and continuous self-test sequence in accordance with one aspect of the present invention.

FIG. 4 is an example of a 1/2" CCD array utilizable in accordance with one aspect of the present invention.

FIG. 5A is a schematic block diagram showing the image signal to digital signal conversion logic in accordance with one aspect of the present invention.

FIG. 5B is a logic and timing diagram for the image signal to digital signal conversion logic in accordance with one aspect of the present invention.

FIG. 6 is an example of the control panel logic in accordance with one aspect of the present invention.

FIG. 6A is an example of one embodiment of switch logic of the control panel switches and controls utilizable in accordance with one aspect of the present invention.

FIG. 6B is an example of the PICT image file format based upon the published standard provided by Apple Computer, Inc.

FIG. 6C is an alternate embodiment of the current invention embodying remote operation.

FIG. 7 is a simplified block diagram of the digital control unit in accordance with one aspect of the present invention.

FIG. 8 is a flowchart showing the steps of the image compression algorithm in accordance with one aspect of the present invention.

5 FIG. 9 is a block diagram of a video format translator device in accordance with one aspect of the present invention.

FIG. 10 is a block diagram illustrating the operation of a translator device in accordance with one aspect of the present invention.

FIG. 11 is an alternative embodiment of the video format translator in accordance with another aspect of the present invention showing additional video inputs and data outputs.

FIG. 12 is an alternate embodiment of the invention showing an optional diskette format utility flowchart.

FIG. 13 is an alternate embodiment of a frame buffer utilizable in accordance with another aspect of the present invention showing a frame buffer stack permitting multiple shot mode.

FIG. 14A is a block diagram of an embodiment of the format select logic in accordance with one aspect of the present invention.

FIG. 14B is a flow diagram illustrating the steps of the format selection logic operations

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 2 is a schematic block diagram of the preferred embodiment of an electronic still camera in accordance with the principals of the invention. Referring to FIG. 2, an image optical pick-up element 1, which for example could be a Charge Coupled Device (CCD) (or an Infrared (IR) or Ultraviolet (UV) sensor), converts a still image of an object into an electric signal when a picture "shoot" command is initiated by the operator via control panel 2. When taking a picture, focusing and shutter speed are controlled by a lens system and shutter speed selection mechanism under control of the digital control unit 9. The camera, like other still video cameras, employs an electronic shutter system that controls a charge storage time in a CCD array onto which an image of an object is focused through the lens system.

When the "shoot" control 6 is half depressed (see FIG. 6), a power supply voltage is supplied from the rechargeable batteries 4 to the electronic circuits and digital control unit 9, control panel 2, and the disk drive assembly 5. The exposure control circuitry not shown generates appropriate horizontal and vertical transfer pulses as well as field shift pulses under control of the reference clock timing and control signals provided by the digital control unit 9 type for driving the CCD

device and pre-processing circuitry. This design may be of any type well known in the art for example those cited in Patents 4,131,919 and 4,456,931 and any similar designs well known in the prior art.

5 An alternate embodiment of the present invention that provides remote operation of the camera is shown in FIG. 6C. When remote "Shoot" control 30 is activated by any means for example manually, or by radiant, or electronic energy, a control signal is generated and routed through the external jack 31, located on the external camera body. The external control 30 is electrically connected to the external jack 31 by a twisted-pair conductive cable assembly that is familiar to those
10 skilled in the art. Upon receipt of the externally generated "shoot" command, the relay switch 32 is activated and provides internal switch closure. This closure of switch 32 then initiates the process previously described and provides the half V+ voltage previously described. The full V+ is provided via the fixed delay 33, the value chosen to allow the diskette drive assembly 5 (FIG.2) and associated control
15 circuitry to initialize prior to receiving image data.

When the "shoot" control is fully depressed in either embodiment, the shutter controller 15 (FIG. 6) generates a shutter pulse that generates control signals for the A/D converters 8 allowing the image/picture data signal in the sample and hold circuitry of the pixel multiplexer 7 to be converted into a digital signal.
20 Control and address instructions of the type well known in the art are generated from the digital control unit 9 to facilitate the storage of the digital image data within the pixel buffer 10 and frame buffer 11. Upon completion of image conversion, the contents of the frame buffer are transferred to the compression processor 12 which for example may be of the many versions currently offered commercially
25 such as C-Cube's (San Jose, California) four chip Application Specific Integrated Circuit (ASIC) set. In the compression processor 12, the Joint Photographic Experts Group (JPEG), a part of the International Standards Organization (ISO) which is a subset of the International Telegraph and Telephone Committee (CCITT), image compression algorithm fully described in Report #
30 JTC1/SC2/WG8 dated 1985 is performed under control of the digital control unit 9 to compress the size of the image. A variable selectable compression ratio of up to 50:1 is performed on the digital image frame. Other compression ratios are operator selectable via the control panel 2 switches 14A and 14B (FIG. 6). The compressed digital frame is then formatted into either an IBM PC/Clone (such as
35 GIFF) or Apple Macintosh (such as PICT II) image file format depending on the setting selected by the operator for a user switch 17 (FIG. 6) position on the control panel 2. After formatting, the file is written into a temporary memory buffer within the disk input/output (I/O) interface circuit 13 which, under the command of

the digital control unit 9, controls the high density (1.4 Mbyte storage capacity) disk drive unit 5. Following file transfer to the diskette e.g., the frame counter display 22 on the control panel 2 is updated by appropriate control signals and the camera is ready to undergo the same procedure for the next image. Power to the electronic circuits and disk drive system is terminated following release of the "shoot" control switch 6.

In accordance with the preferred embodiment of this invention, it is permissible for the user to select various resolution quality image recording levels with the higher levels being at the expense of memory diskette storage capacity. The position of switches 14A and 14B for example could represent a unique digital mark or word that denotes the respective switch position and is sensed during initial power application and periodically during operation. FIG. 6A illustrates typical logic AND gate circuits 60a and 60b utilizable in conjunction with switches 14A and 14B or switch 17 to generate appropriate signals to designate respective switch positions and generate appropriate control signals from. The switch positioned in the High position for high resolution allows only four to five images to be stored, while Med. switch position for medium resolution allows approximately twenty five images to be stored, and Low for low resolution allows up to fifty images to be stored on a single diskette. Also, by selecting black and white mode instead of color via switch 14B, the operator may select additional storage capacity since storage is increased by a factor greater than three (one element per pixel versus three for color). Various image resolution combinations are permissible because the operator can select a different resolution and mode setting for each image prior to image signal capture. This is accomplished by marking or "tagging" each image frame data information signal with the resolution and mode of each image as it is written onto the memory diskette in any suitable manner, for example as shown in FIG 2A. With reference to FIG 2A, diskette 50 has tracks 51a, 52b, ..., 52n. With reference to track 52b there is shown a representative portion of segment 53 depicting a typical image file information format having digital bit 54 depicting color mode, and digital bits 55 representing compression resolution level markings or tags. With reference to color mode tag 54 it can be seen that if switch 14B is in the color position tag 54 is recorded as a logical "one" or true-conversely if bit 54 is recorded as a logical "zero" it corresponds to the black and white position of switch 14B. Similarly as shown switch 14A would record in memory position 55 a binary "zero" for low resolution, a binary "one" for medium resolution and a binary "two" for high resolution selections by the operator. By incorporating this "tagging" approach, it is possible for the decompression algorithm, loaded into any PC prior to use or written onto the memory storage

diskette along with the image data, to automatically determine the appropriate level of compression associated with image file and execute decompression efficiently.

Still another alternate embodiment in accordance with this invention incorporates an acoustic digitizer circuit which digitizes sound. There are several
 5 digitizers commercially available such as the Apple Computer Inc. Musical Instrument Data Interface (MIDI) adaptor. The output of this digitizer may be selectively connected to the CPU 20 (FIG 7) via an additional I/O interface similar to the auxiliary I/O interface 80. The sound or audio associated with each image can be recorded, digitized, and stored on the diskette device on available tracks in
 10 an identical manner previously described (FIG 2A). An image file in accordance with this embodiment would be appropriately marked or tagged with the corresponding digitized audio file 56 (FIG 2A). Upon playback on a sound configured PC, both the image and the corresponding audio would then be viewed and heard simultaneously.

15 It should be noted that a major advantage a camera in accordance with the present invention has over conventional still video cameras is that a camera according to this invention is capable of storing multiple digital images in semiconductor memory temporarily at a rapid rate while, simultaneously, the image compression processor 12, file formatter software algorithm, and disk I/O interface
 20 13 that stores formatted files continue to function in concert together at a slower rate. This efficient design coupled with VLSI low power, high speed semiconductor memory devices (10 & 11 FIG. 5A and 24 FIG. 7) allows this operational capability.

Like most other still video and conventional film cameras, when the "shoot"
 25 control 6 (FIG. 6) is fully depressed, a control signal is generated from the digital control unit 9 that generates a trigger signal on the control panel 2 to cause a flash unit 16 (FIG. 6) to irradiate a flash of light onto the subject image.

During initial camera operation, the user first inserts a diskette such as a standard three and a half inch or similar storage medium. Various memory diskette
 30 sizes and formats are suitable for the invention. However, for the preferred embodiment either a double-density (800 Kbytes of storage) or a high-density (1.4 Mbytes of storage) diskette in a three and a half inch format which are readily available from various commercial sources such as Sony, Maxell, and Verbatim. The user must then select the desired PC format (IBM PC/Clone or Apple
 35 Macintosh, etc.) via switch 17 (FIG. 6) on the control panel 2. As shown in FIG. 3.; after turning on the power switch or inserting a diskette 50, the digital control unit 9 performs a self test of all internal circuitry, battery, disk drive unit, and control panel. Should any failures be detected, an appropriate error indicator is

illuminated on the control panel. During the power-on sequence (see FIG. 3 and FIG. 12), the inserted diskette 50 is automatically checked for formatting consistencies in accordance with the format selected by the format switch 17 on the control panel 2 (IBM/Apple/etc.) and for available storage space by checking the boot block on the diskette, a technique that will be familiar to those skilled in the art. Should any inconsistencies be detected, an error indicator is illuminated on the control panel (ie, disk full, unformatted, etc.). The operator frame counter display 22 (FIG. 6) is then updated to show the maximum number of pictures available based upon indicated operator selections (color/black and white), diskette type (double versus high density), and capacity (partially full versus empty diskette). During operation, the operator can selectively erase a frame and record over it if desired by selecting the erase mode of operation from the control panel and toggling the forward/reverse control.

The optics for the preferred embodiment of the invention is a commercially available one-half inch (1/2") color CCD device having a pixel grid array of 780 x 488 as pictorially depicted in FIG. 4. This results in 380,640 pixel elements which results in a commercially acceptable quality resolution image as will be understood by those skilled in the art. In a color imaging device (CCD array) photoelectric elements, such as photodiodes, are arranged in a two dimensional array with optical filters for R (red), G (green), and B (blue). Various arrangements of optical filters are well known and the arrangement of optical filters is not limited to a particular one with this invention. During operation each pixel stores a charge corresponding to the amount of incident light. The RGB components of each pixel's charge is sequentially read out via a horizontal / vertical addressing scheme that will be familiar to those skilled in the art.

As shown in FIG. 5A; each charge, when addressed, is amplified and processed in a sample and hold (S/H) circuit 18. The analog voltage in each S/H circuit is digitized by an associated analog to digital (A/D) converter 8. The digital values are routed and collected in the pixel buffer 10. Following completion of discrete pixel element conversion and subsequent formatting in the pixel buffer which is under Control Processor Unit (CPU) 20 software control, the output of the full pixel buffer is routed to the frame buffer 11 by digital control unit 9. This process continues until a complete frame is collected within the frame buffer. The general digital logic and timing and control signals for this circuitry is shown in FIG 5B. The timing is provided by a master clock that is an integral part of the CPU microprocessor. For example, the MOTOROLA 68040 microprocessor has a clock speed of approximately 40 Megahertz (MHZ) which results in a clock period of 25 nanoseconds (nsec.). This clock pulse is used by the function and address decoder

19 (FIG. 6) to generate the address and control signals shown in FIG 5B as would be understood by those skilled in the art. The circuit of the present invention may be designed by one skilled in the art to function with a variety of microprocessor architectures and is not limited to any one in particular. One can see from the timing chart that the S/H circuit is allowed (via the SE command) to charge to a voltage level indicative of the analog voltage impinging upon the pixel element (via the PS command). After a fixed time period, the A/D converters are enabled (via the CE command) to begin conversion of the analog voltage value on the S/H. Upon completion of conversion, a conversion completion signal (CC) is generated by the A/D and routed back to the S/H circuit (via the SC command which is generated by the function and address controller 19) to discharge the stored analog voltage in anticipation of the next pixel element conversion process. Next, the output of the A/D converter 8 is clocked into the pixel buffer 10 (via the PB command). When the pixel buffer 10 is full, the output is clocked out to the frame buffer 11 (via the FB command) and the pixel multiplexer address circuitry selects the next pixel for conversion. Reset signals (RST) are sent to all circuit elements to allow these devices to reset prior to receiving the next analog value.

Another novel concept of the present invention as illustrated in FIG. 5A and 5B utilizes a technique of paralleling the S/H and A/D devices for each pixel element thus accelerating the image signal analog-to-digital conversion process. This is accomplished by eliminating the serial S/H and A/D path typical of prior art still video camera designs. In addition, high-speed, low-power devices available from Sony, Burr-Brown, Datel, Analog Devices, and others facilitate the increased conversion throughput of the S/H and A/D circuits with pixel conversion times of less than 150 nanoseconds (nsec.). For example, Sony's video A/D converter Device part number CXA1016P/K performs up to 50 million samples per second or 20 nsec. per conversion. This device, or similar, may be used in the preferred embodiment of the present invention. As explained previously, prior art still video camera designs multiplex each signal component into a common/singular A/D path to reduce the number of components and power consumption. However, in accordance with another aspect of the present invention components such as CMOS and ECL devices coupled with miniaturized packaging techniques such as surface mount devices (SMD) and ASIC technology make it feasible to incorporate these devices in a parallel design in order to realize a substantial increase in conversion speed with no appreciable increase in power consumption. Therefore, this design approach provides significant conversion throughput increases over previous designs.

The extremely high conversion speed in accordance with another concept of the present invention makes multiple high-speed camera operation possible in an alternate embodiment. For example, total conversion time required for the aforementioned CCD array utilizing the circuit of the present invention (FIG 5A) requires approximately $380,640 \times 150$ nsec. or 38 milliseconds (msec.). Additional time (approximately 5 msec.) is required for timing and control signal latency. Thus, total conversion time for a complete image frame prior to compression processing and logging to the memory storage diskette 50 is less than fifty msec. This allows for approximately 20 images to be captured in a one second period. By adding additional RAM 11A (FIG.13) or other forms of commercially available random access memory to the frame buffer 11, image frames could be "pushed" onto a semiconductor memory stack for temporary storage allowing the compression processor and data interface circuitry to perform their respective functions at a slower rate. As shown in FIG 13, each unprocessed image frame would be recorded or "pulled" from the stack on a "First-In, First-Out" (FIFO) manner until all images in the stack queue were processed and written to the storage diskette via the disk I/O circuitry 13.

As shown in FIG. 6, control panel settings are monitored by the CPU 20, a microprocessor, thus allowing the appropriate timing, control, and signal processing to be effected properly. The microprocessor 20 may be of the type 68040 manufactured by MOTOROLA, Intel's 80386 series, or equivalent microprocessors which specifications are commercially available and are incorporated herein by reference. The microprocessor utilization of this invention, which is in the digital control unit 9, transmits commands and status to specific controls, functions, and displays in the control panel as well as receiving both circuit status/control data and operator commands through polling the operator switch settings 14A, 14B, and 17 via the bidirectional function and address decoder 19. This approach allows the user to know immediately how much storage capacity remains in the image storage diskette 50 as well as the camera's overall operational and functional status through the use of status displays 21, 22, and 23 and ongoing software self-tests running in the background as depicted in FIG. 3. An example of this would be a low battery situation. First, the digital control unit 9 would detect a failure in the self-test mode. Next, the self-test light emitting diode 21 (FIG. 6) would be illuminated and an appropriate error display would be illuminated in the status display 22 thus providing the user with an exact indication of the error. Another example illustrating the operation of this embedded microprocessor type of control approach is the format switch 17 (FIG.6). The position of the format switch 17 is sensed upon power application. Following

diskette insertion, the boot block on the diskette is compared with the format switch 17 setting (IBM/clone or Apple) and if the format does not match or if the disk 50 is unformatted, the disk format status light emitting diode 23 would be illuminated and an appropriate error display would be illuminated in the status display 22 thus prompting the user to take appropriate corrective measures.

An alternate embodiment of the present invention involves adding an auxiliary I/O interface circuit or port to the digital control unit 9. As shown in FIG. 7, the auxiliary I/O port 80 connects in a manner similar to the Disk I/O interface 13. This additional I/O channel provides for external control and monitor of all timing and control signals internal to the camera. In addition, it allows for the image data to be routed past or around the compression processor out to any additional internal or external device such as an optical disk storage device, digital analyzer, or other data processors that might be desired.

FIG. 7 shows the digital control unit 9. The microprocessor 20 architecture here is typical to one familiar with the art. The frame buffer 11 (FIG. 5A) receives and stores the outputs of the pixel buffer 10 until a complete frame of image data is received. Then, the CPU 20, under software control, issues a control signal to the optics logic in the shutter and control circuitry 15 (FIG. 6) thus resetting those functions for future image recording. The full frame buffer 11, upon command from the CPU 20, transfers its data into the compression processor 12 (FIG. 2) which performs thousands of levels of parallel pipeline processing on the image data. The compressed image frame is then written out to the mass memory RAM (Random Access Memory) 24 where it is temporarily stored until transferred to the disk drive assembly 5 via the disk I/O interface circuitry 13.

Referring to FIG. 8, a flowchart shows the steps involved in the image compression process performed by the image compression processor 12 (FIG. 2) in accordance with the preferred embodiment of the present invention. The output of the frame buffer 11 is transferred into the input of the image compression processor 12 under the control of the digital control unit 9. As previously described, the setting of switch 14A (FIG. 6) is read by the CPU 20 (FIG. 7) to determine the image resolution quality desired. Depending on the operator selected setting of switch 14A, the unique digital word generated by the AND gate 60a-b (FIG. 6A) which is activated by the selected position of switch 14A is routed to image compression processor 12 via CPU 20 (FIG. 7) which selects for example a predetermined digital memory location containing the appropriate corresponding compression ratio parameters under program control. The compression processor uses this command value for example to establish the size of the covariance matrix and a threshold for acceptance for the variances produced by the Discrete Cosine

Transformation (DCT) transform coefficients. Next, the digital image signals are converted from the RGB format previously discussed in connection with Figures 2, 5, and 6 into luminance and chrominance signals. The luminance and chrominance signals subsequently undergo a DCT. The cosine transformed signals are then quantized and are then processed for Huffman coding. The Huffman coded image signals are then formatted into a form that facilitates format processing into various PC compatible formats (GIFF, PICT2, etc.). For a more complete understanding of the image compression process reference may be made to I.E.E.E. Catalog No. EH0231-1, Library of Congress No. 85-60384 published by the I.E.E.E. Society dated 1985 and incorporated herein by reference.

Of the two traditional classes of image compression techniques, spatial coding and transform coding, transform coding techniques lend themselves well for this application due to computational simplicity. Transform coding techniques that provide good visual fidelity include: Karhunen-Loeve transform (KLT), Fourier, cosine, sine, and Hadamard. The KLT algorithm offers the best visual fidelity but suffers from serious computational complications due to extremely large matrix size. Several alternate algorithms that offer reasonable visual fidelity that are computationally feasible for this invention include the Fast Fourier Transform (FFT), Discrete Cosine Transform (DCT), and Discrete Sine Transform (DST). The DCT was adopted by the JPEG as the preferred algorithm due to computational simplicity and performance.

It should be noted that the Joint Photographic Experts Group (JPEG) (composed of experts from many companies including IBM, AT&T, Digital Equipment Corp, and INTEL) compression/decompression standard was developed in 1985 in response to the lack of interoperability between image and processing equipment due to numerous proprietary standards held by each manufacturer. The JPEG standard provides image compression effectively up to 75 times or greater depending on the visual fidelity desired. The JPEG standard is widely used in industry as an alternative to proprietary algorithms such as Intel's own proprietary standard called DVI which was initially developed by RCA before being sold to INTEL, the integrated Circuit manufacturer. INTEL offers it's own firmware compression processor incorporating their DVI standard delivering compression ratios in excess of 100:1. However, a new international standard called MPEG is due to be announced in the 1991 time frame from the JPEG and should offer compression ratios of 275:1 and greater. In the preferred embodiment of the present invention, the JPEG standard is the preferred algorithm chosen with the incorporation of the the MPEG standard or other similar standard in the future when available commercially. An alternate embodiment of the present invention would be

the incorporation of various proprietary compression algorithm standards such as DVI.

The compression/decompression algorithm firmware implementation of the JPEG algorithm is available commercially from various sources including C-Cube, Electronics for Imaging, Storm Technology, Burr-Brown, Spectral Innovations Inc., INTEL, and others. The implementation of this algorithm for the present invention may incorporate the integrated circuit set commercially available from C-Cube. Their four chip ASIC JPEG algorithm implementation is performed in three basic steps: first, the image is divided into 8-by-8 pixel squares and applies a discrete cosine transform (DCT) to each square resulting in 64 frequency values; second, these frequencies are put through a quantization algorithm to eliminate unimportant frequencies; third, the remaining values are run through a Huffman coding scheme to encode the most frequently occurring values using the fewest bits. A compatible software implementation of the JPEG algorithm is available commercially from Aladdin Systems, Radius Inc., Kodak, and others.

Those skilled in the art will be familiar with the process and the commercially available software and firmware chipsets that are currently available on the market. The present invention incorporates both available firmware chipsets in the camera and software for use in the PC for decompression. The decompression algorithm can be written onto the camera's diskette 50 prior to any image data recording. This allows the PC user to take the diskette 50 to a PC and directly incorporate the image data because the image file selected by the user is automatically decompressed transparent to the user. The algorithm can be written onto an unused track 52 or sector combination on the diskette as shown on FIG 2A. Alternatively, the decompression algorithm can be loaded onto a PC before inserting a diskette 50 containing compressed image data. In the latter embodiment the resolution and mode values 54 and 55 (FIG 2A.) for each representative image would be read from diskette 50 in order to appropriately control the selection and activation of the appropriate corresponding decompression algorithm.

As shown in FIG.7, the output of the image compression processor 12 is routed to the RAM memory 24 where the compressed image is formatted for either the PICT II or GIFF format depending on the setting of format switch 17 (FIG. 6). It should be noted that a large number of image formats for PCs exist. PICT and GIFF are the most common for the Apple and IBM PC's and are therefore the preferred formats for the present invention although other formats can be easily incorporated into the design by changing the software format routines. These software image formats are commercially available from many sources most notably Apple computers for PICT and IBM for GIFF. An example of the PICT format is

pictorially shown in FIG. 6B as will be familiar to those skilled in the computer arts. Once formatting is complete, the formatted image data is transferred to the disk I/O interface 13 for transfer to the magnetic recording diskette 50.

FIG. 9 and FIG. 10 illustrate the preferred embodiment of the video format translator device in accordance with another aspect of this invention that converts other still video camera formats for example on two inch video diskette to this invention's selectable PC compatible digital format. The general concept of operation is shown in FIG. 10. In FIG. 9 correspond parts and subassemblies in translator 40 are shown with like numbers corresponding to FIG. 2 and 6 having a 40 hyphenation prefix designation and such parts and subassemblies perform similar functions to those described above with reference to FIG.s 2 and 6. Referring again to FIG. 9, the translator 40 incorporates the same components utilized in the digital circuit card assembly which houses both the digital control unit 9 and optics processing circuits (pixel multiplexer 7, A/D 8, etc. 10-13). The major difference is that the CCD array 1 is replaced with an input disk drive 25, for example a two inch (2") video disk drive assembly, and an NTSC video format decoder 26 which converts the composite video signal to an RGB format for processing as described previously.

FIG 11. displays an alternate embodiment of the video format translator device 40 of the present invention that shows optional inputs 27 and outputs 28 and 29. The exact same circuitry is utilized that was used for the translator device 40 as shown in FIG. 9 except that inputs 27 for either an NTSC/PAL format or RGB format video signal is provided. This allows video signals from other sources such as a cable TV, CAMCORDER, or other video signal source to be digitized and archived in a PC compatible format. Also, provisions for video output jacks 28 are made to allow either viewing of the image / video source prior to or during image recording. Finally, provisions are made to provide a data output 29 to allow connection to other PC peripherals such as a communications modem, larger/smaller disk drive assembly, optical disk, specialty display or signal processor / analyzer. Either a standard serial, parallel, or Small Computer Standard Interface (SCSI) data port can be readily connected to the auxiliary I/O interface 80.

FIG. 12 depicts an alternate feature of an embodiment of the present invention that shows how an inserted diskette 50 that is either unformatted or formatted for a undesired (e.g., not corresponding to the setting of switch 17-FIG. 6) PC configuration would be automatically properly formatted for use with a camera in accordance with another aspect of this invention. This capability allows the user of this invention to forego the requirement to pre-format the storage medium (diskette) on a PC prior to using it in the camera operated in accordance

with the present invention. With reference to FIG.3 the power-on sequence process would result in an abnormal diskette format error if the format of an inserted diskette 50 did not correspond to the operator selected format switch 17 (FIG.6). In accordance with the automatic diskette format option, CPU 20 of digital control unit 9 in response to the abnormal diskette format error would initiate the diskette format process illustrated in FIG.12. Upon completion of the diskette format process illustrated in FIG.12, the power-on sequence illustrated in FIG.3 would continue from step B.

Referring now to FIG. 14A, there is shown a schematic block diagram of the format selection logic in accordance with another aspect of the present invention. During the power-on sequence as described in connection with Figures 3 and 12, processor 20 of control unit 9 initiates a format selection switch sample and test routine as more fully described in the flow diagram illustrated in FIG. 14B. Switch 17 is illustrated in FIG 14A in the Apple PC position and logic level v1 is applied as inputs to logic gates 60c and 60d. As illustrated in FIG. 2A, the format signals 57 for the Apple PC format is a logic "zero" and conversely the format signal or tag 57 if the format switch 17 were in the IBM PC or other computer type position would be a logic "one" and "two" respectively. In response to the logic "zero" indicating Apple PC format, processor 20 accesses a unique memory location XY of format memory 20-2 which for example may comprise any random access memory with two megabytes storage capacity. The data format for the operator selectable predetermined number of computer architectures, similar in content and arrangement to those illustrated in FIG. 6B for an Apple PC would be stored in memory 20-2 which would be addressed in response to the other operator selectable position of switch 17 to generate the other unique codes 57 as shown in FIG 2A. Processor 20 in response to a stored format subroutine more particularly shown in FIG. 14B contains the allocation of data memory addresses in disk input/output interface unit 13 in accordance with the picture image file format as illustrated in FIG. 6B. Thus the digital video data information signals generated by compression processor 12 are appropriately formatted and stored in memory storage disk drive 5 to insure compatibility with the format selected by the operator by selectively positioning switch 17.

Those skilled in the art will recognize the many alterations, additions or changes of the preferred embodiment may be made without departing from the scope of the following claims.

What is claimed is:

Claim 1. In an electronic still image camera comprising:

an optical lens,

5 a shutter mechanism operably associated with said lens,

an array of discrete light sensing pixel elements, each pixel element being responsive when said shutter mechanism is operated to incident illumination from a subject image radiating through said lens and shutter mechanism to generate an analog picture information signal corresponding to said subject image,

10 pixel multiplexing means responsive to each array of pixel elements for separating an output from each pixel element into its primary color components,

15 analog to digital converter means responsive to the outputs of said pixel multiplexing means for converting said analog signals into corresponding digital data information signals,

20

digital data compression means for applying
a digital data compression algorithm to said
25 digital data information signals to generate
compressed digital data information signals, and
removably mounted memory means for storing
said compressed digital data information signals,
the improvement comprising operator
30 selectable control means for controlling digital
data format compatability between said compressed
digital data information signals and one of a
plurality of operator selectable types of computer
apparatus.

35 Claim 2. The improved electronic still
image camera of Claim 1 further comprising switch
activated control means for improving the image
signal storage efficiency by selectively
determining the amount of storage of said removable
40 memory means to be associated with storage of each
picture image.

Claim 3. The improved electronic still
camera of Claim 1 further comprising picture image
resolution determining means for selectively
45 determining which of a predetermined set of
compression algorithm parameters are to be applied
to said digital data information signals in
response to an operator activated switch means.

Claim 4. The improved electronic still
50 camera of Claim 3 further comprising record marking
means for generating and recording with each said
image digital data information signals a coded mark
indicating the compression algorithm parameters
utilized in compressing said image digital data
55 information signals.

Claim 5. The improved electronic still
image camera of Claim 1 wherein said removable
memory means comprises digital data diskette means
having thereon a plurality of selectively
60 addressable magnetic sector and track sections for
recording said compressed digital data information
signals.

Claim 6. The improved electronic still
image camera of Claim 1 further comprising memory
65 formatting means operable during the camera
power-up routine to automatically format said
memory means in accordance with one of a plurality
of operator selectable type of computer apparatus.

Claim 7. The improved electronic still
70 image camera of Claim 5 wherein said digital data
compression algorithm of said digital data
compression means is also recorded in its entirety
on said diskette means and further comprising
record marking means for recording a digital coded
75 mark for indicating the compression algorithm
parameters utilized in compressing each said image
digital data information signal.

Claim 8. The improved electronic still
image camera of Claim 1 further comprising audio
80 recording means for simultaneously recording audio
signals associated with each subject image and
memory file correlation means for associating in

85 said memory means the respective storage locations
of said audio signals with its associated image
signals.

90 Claim 9. The improved electronic still
image camera of Claim 3 further comprising record
marking means for recording a unique mark
indicating the compression algorithm parameters
utilized in compressing each said image digital
data information signal.

Claim 10. An electronic still image camera
comprising:

95 an optical lens,
a shutter mechanism operably associated
with said lens,

100 an array of discrete light sensing pixel
elements, each pixel element being responsive when
said shutter mechanism is operated to incident
illumination from a subject image radiating through
said lens to generate an analog picture information
signal corresponding to said subject image,

105 pixel multiplexing means responsive to said array of pixel elements for separating an output from each pixel element into its primary color components,

110 analog to digital converter means responsive to the outputs of said pixel multiplexing means for converting said analog signals into corresponding digital data information signals,

115 digital data compression means for applying a digital data compression algorithm to said digital data information signals to generate selectively compressed digital data information signals,

removably mounted memory means for temporarily storing said compressed digital data information signals,

120 and selectable control means for controlling digital data format compatability between said compressed digital data information signals and one of a plurality of predetermined selectable types of computer apparatus.

125 Claim 11. The electronic still image
camera of Claim 10 further comprising memory
formatting means operable to automatically format
said data stored in memory means in accordance with
one of a plurality of operator selectable data
130 storage formats.

 Claim 12. The electronic still image
camera of Claim 10 further comprising image
resolution determining means for selectively
determining which of a predetermined set of
135 compression algorithm parameters of said digital
data compression means are to be applied to said
digital data information signals.

 Claim 13. The electronic still image
camera of Claim 12 further comprising record
140 marking means for marking each said image digital
data information signal to indicate which one of
said predetermined set of compression algorithm
parameters were utilized to compress said image
digital data information signals.

145 Claim 14. The electronic still image
camera of Claim 10 wherein said removably mounted
memory means comprises digital data diskette means
and further comprising selectable diskette
formatting for automatically formatting said
150 diskette means in accordance with one of a
plurality of operator selectable data format types.

Claim 15. A process for storing an
electronically sensed video image of an electronic
still image camera comprising the steps of:

155 Generating an analog signal corresponding
to the radiant light incident on a predetermined
number of light sensing pixel elements to generate
analog image signals,

160 Converting the analog image signals into
digital electronic information signals wherein a
distinct digital electronic signal corresponds to
the analog image signals corresponding to the
intensity of radiant light falling on the light
sensing pixel elements,

165 Temporarily storing the digital electronic
information signals,

 Compressing the digital electronic
information signals by applying a data compression
algorithm to sort digital electronic information
170 signals,

 Selecting one of a plurality of
predetermined data formats corresponding to a like
plurality of data formats of a like number of types
of computer apparatus, and

175 Storing said compressed digital electronic
information signals in said predetermined data
format in a digital memory.

 Claim 16. The process of Claim 15 further
including the steps of:

180 Detecting the presence or occurrence of one
or more of a predetermined number of conditions,
and

 Selectively activating said generating of
the analog signal in response to the detection of
185 said condition.

Claim 17. The process of Claim 15 further including the steps of:

Recording audio signals which relate to said analog image signals, and

190 Storing said audio signals in operable conjunction with said digital information signals such that both the audio and image signals can be retrieved.

Claim 18. An electronic video still image
195 camera data format translator comprising:

Input means for producing electronic analog image signals corresponding to the outputs of a plurality of light sensing pixel elements corresponding to a predetermined number of discrete
200 image sensing elements.

Analog to digital converter means for converting said analog image signals into corresponding digital image signals corresponding to said array of such predetermined number of
205 discrete image sensing elements.

Buffer means for storing image forms.

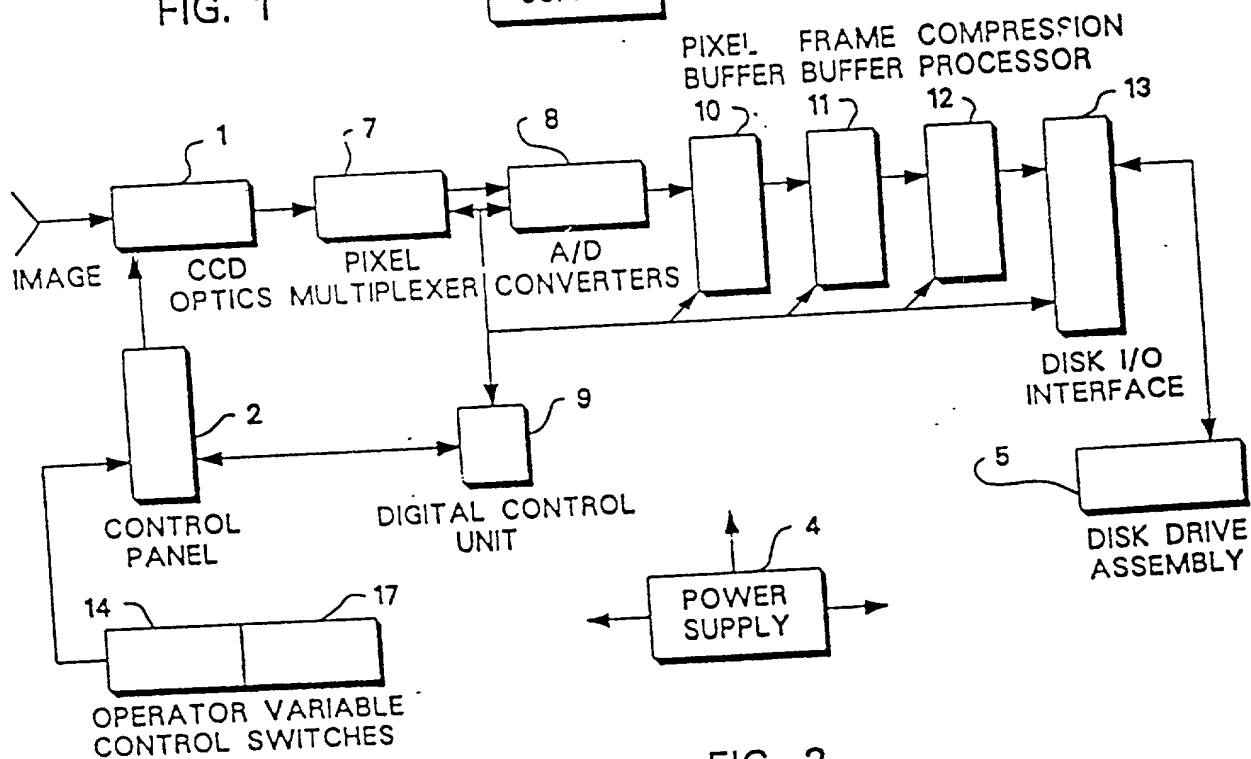
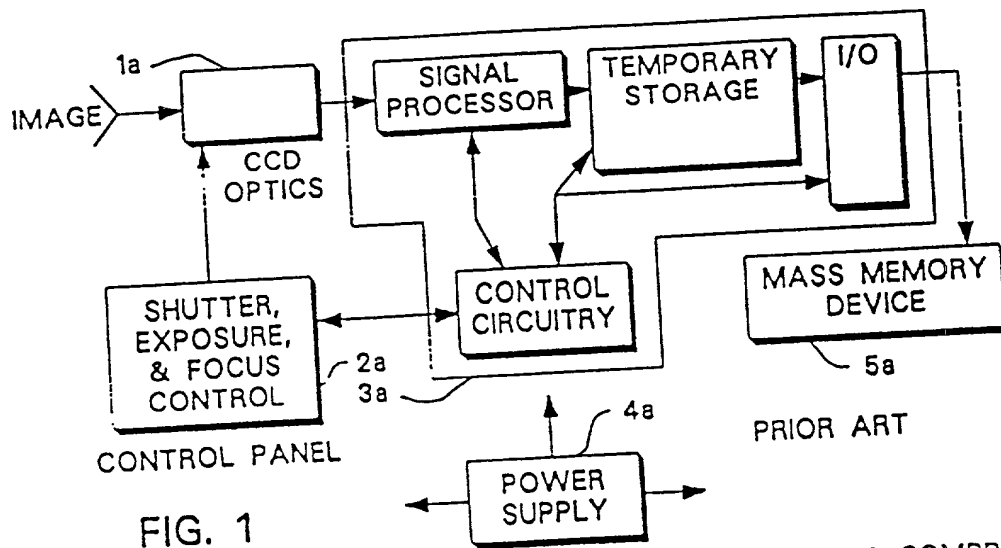
Compression selection means for applying a predetermined compression algorithm to said digital image signals.

210 Format selection means for determining one of a number of predetermined data formats in which said compressed digital image is to be stored and

Removable memory means for storing said digital images in said predetermined data format.

215 Claim 19. The electronic still image camera of Claim 10 wherein said pixel multiplexing means further comprises parallel processing switching means for simultaneously parallel processing the output of each such pixel element.

220 Claim 20. The electronic still image camera of Claim 10 further comprising remote activation means for selectively activating said camera.



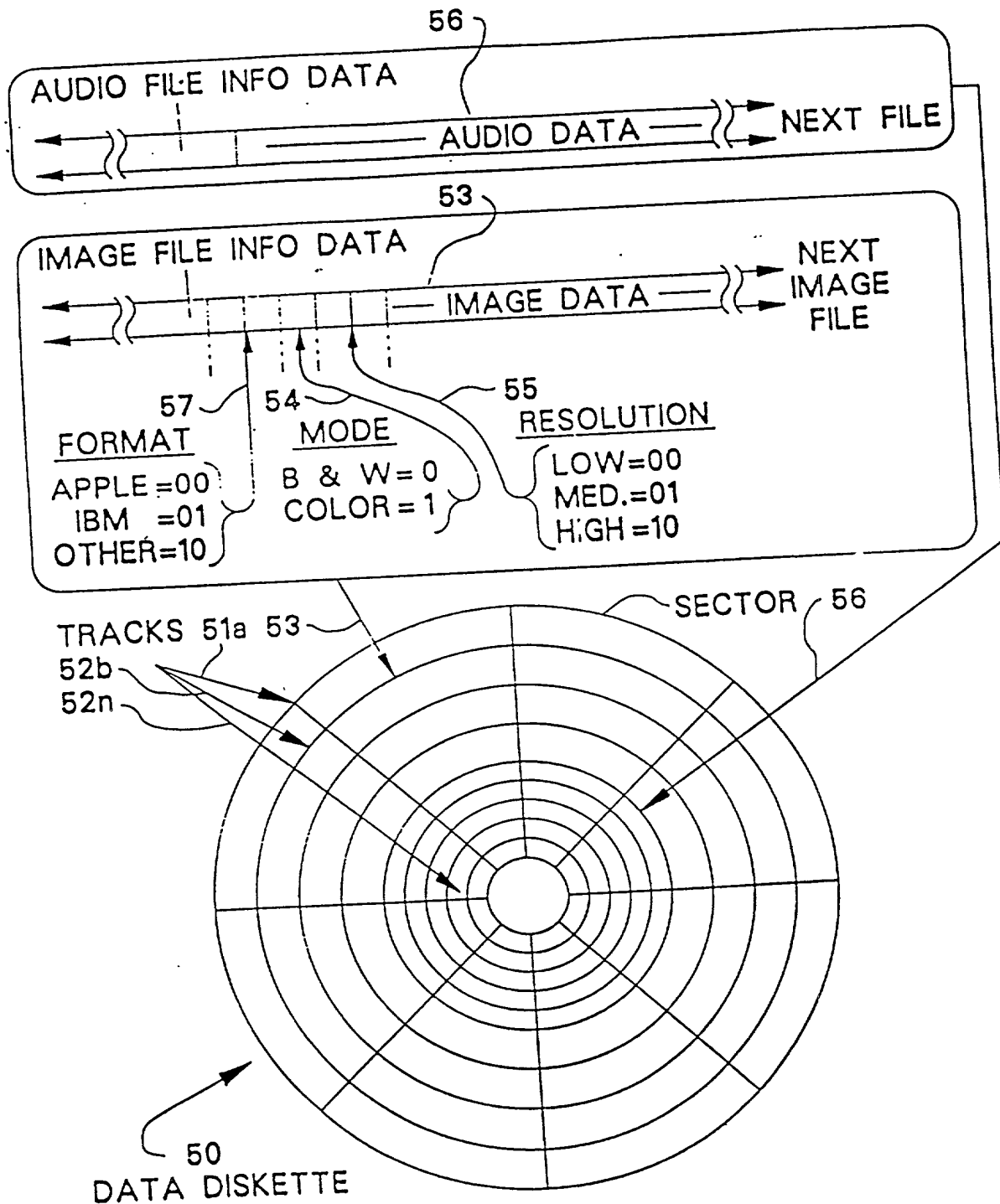


FIG. 2A

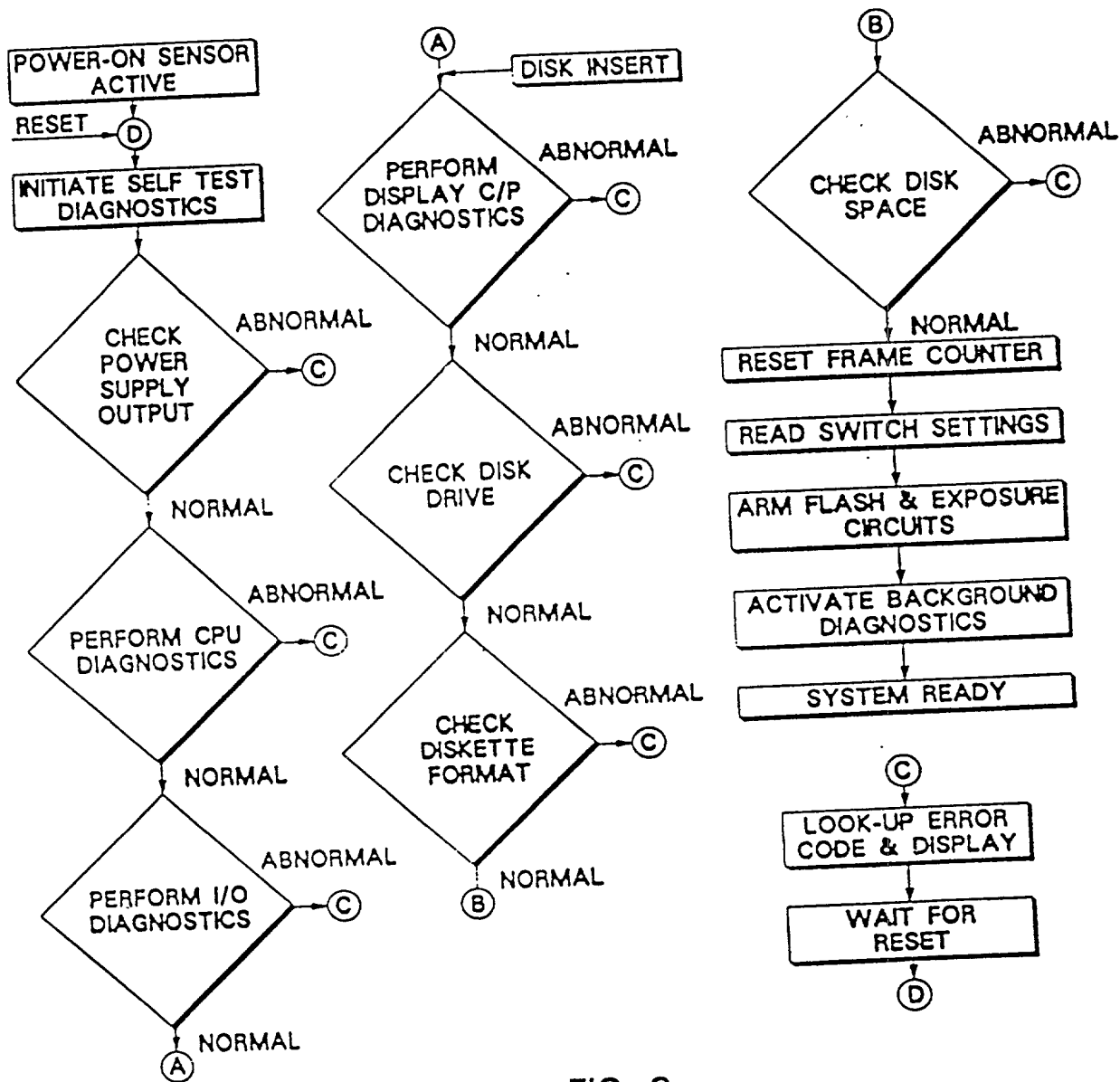


FIG. 3

FIG. 5 A

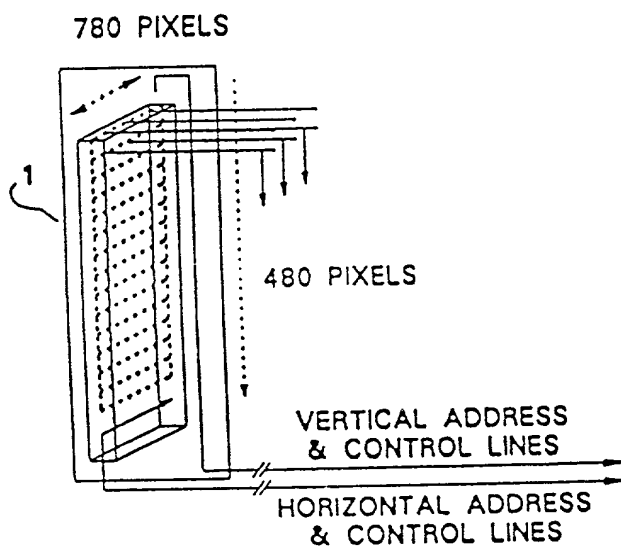
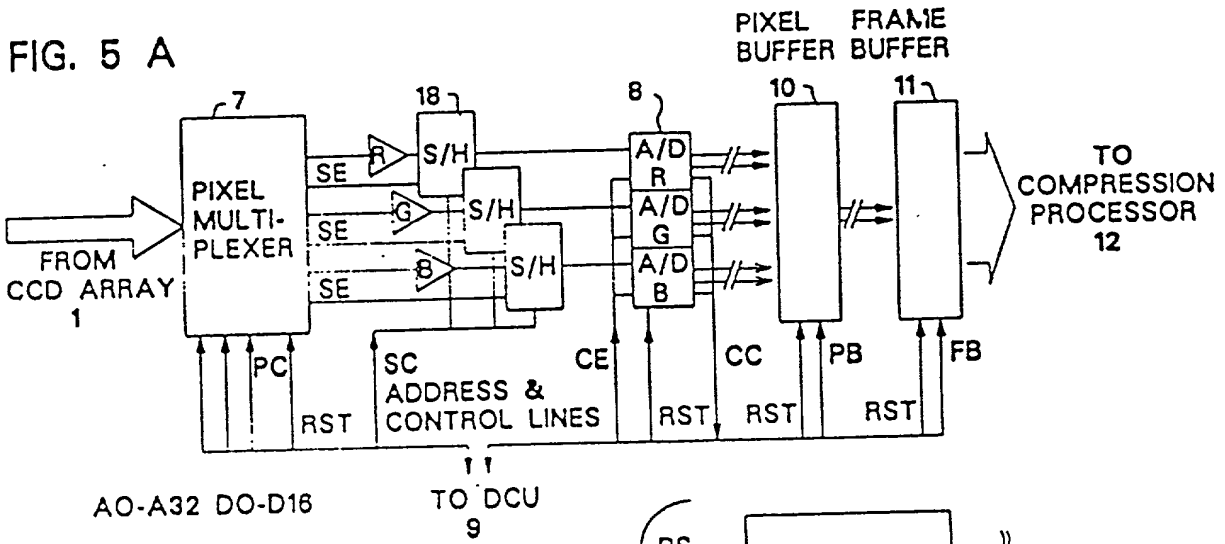


FIG. 4

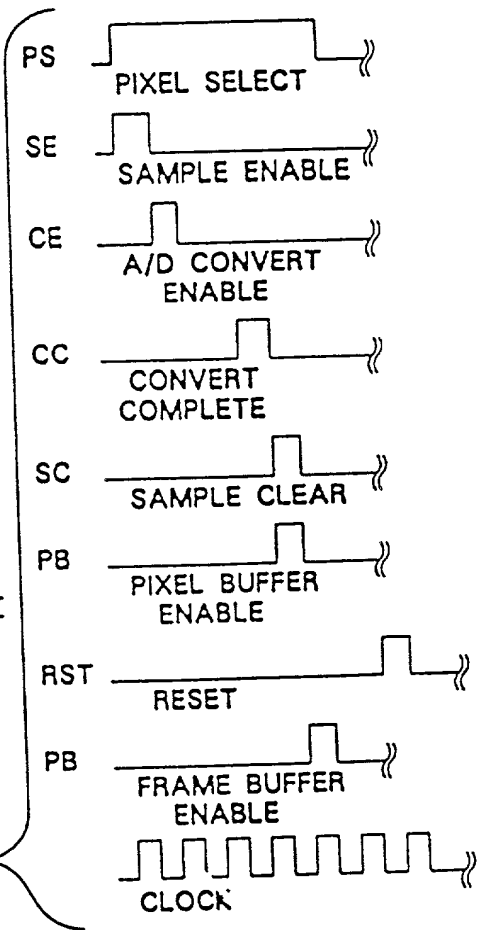


FIG. 5B

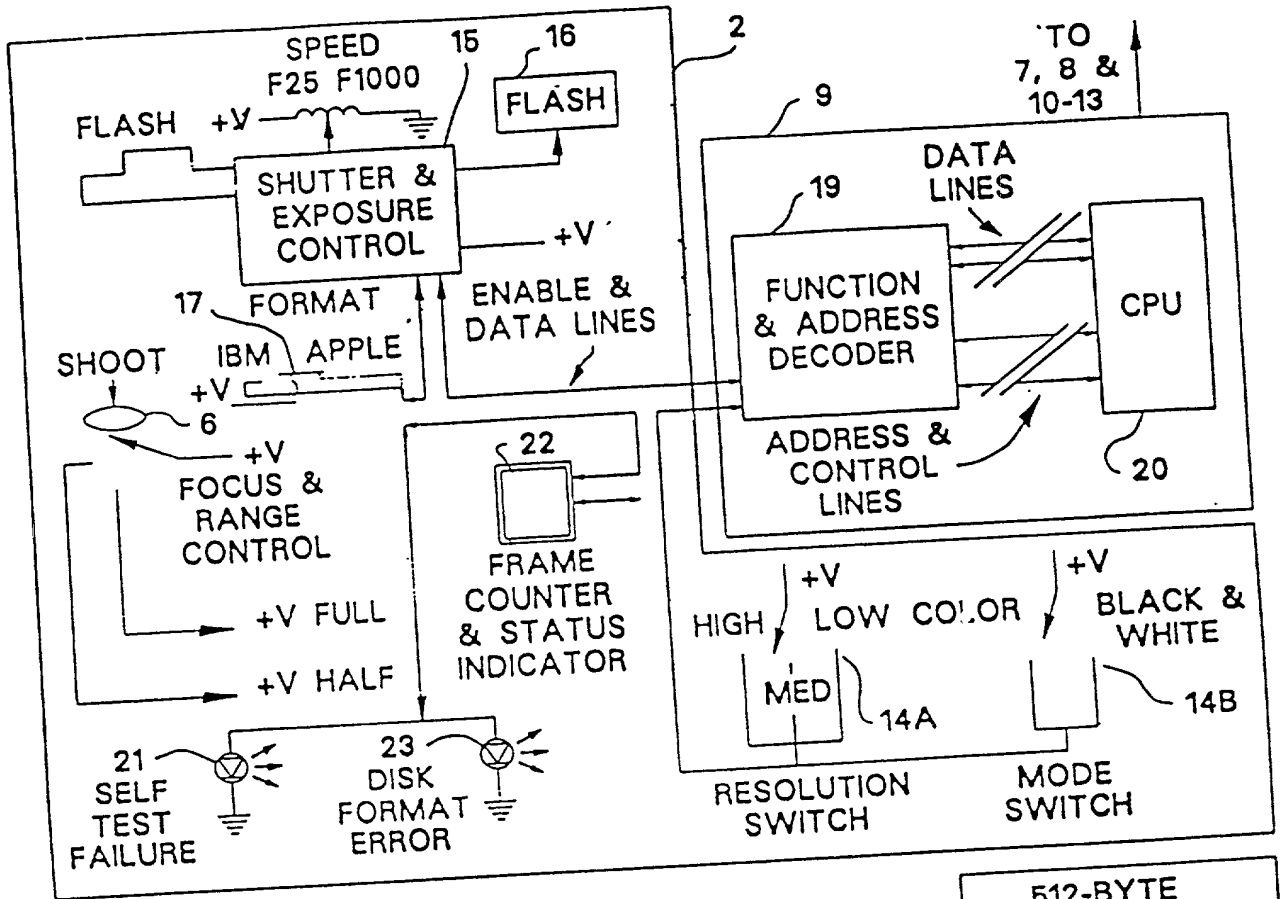


FIG. 6

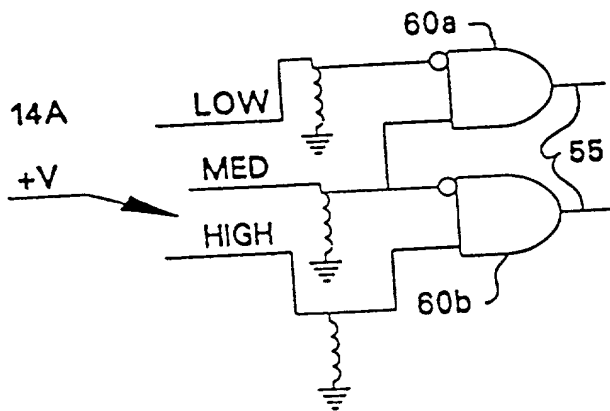
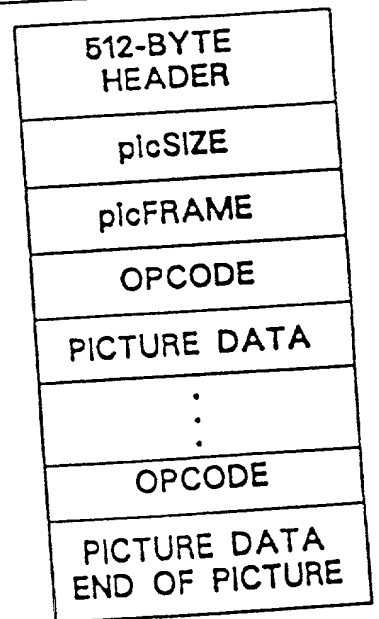


FIG. 6A

FIG. 6B



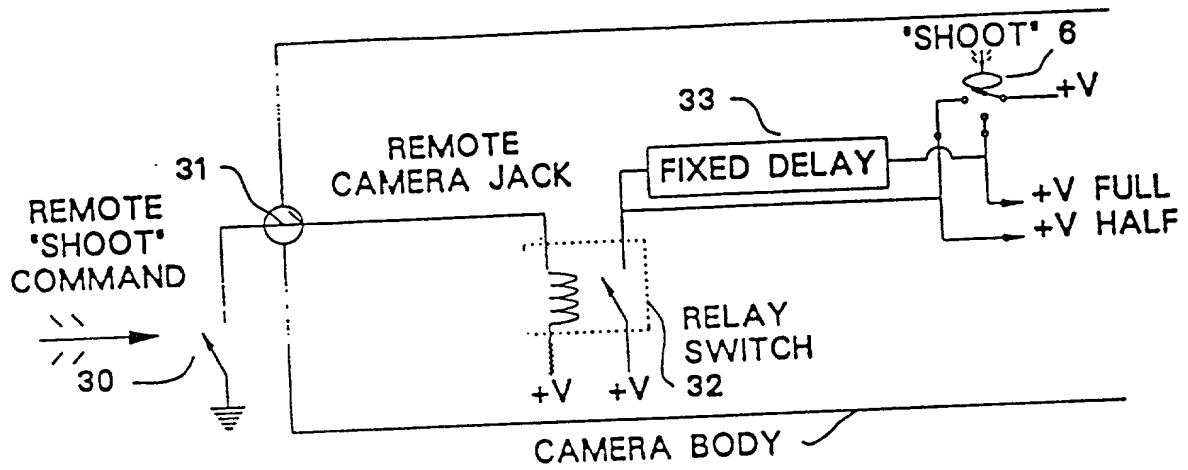


FIG. 6C

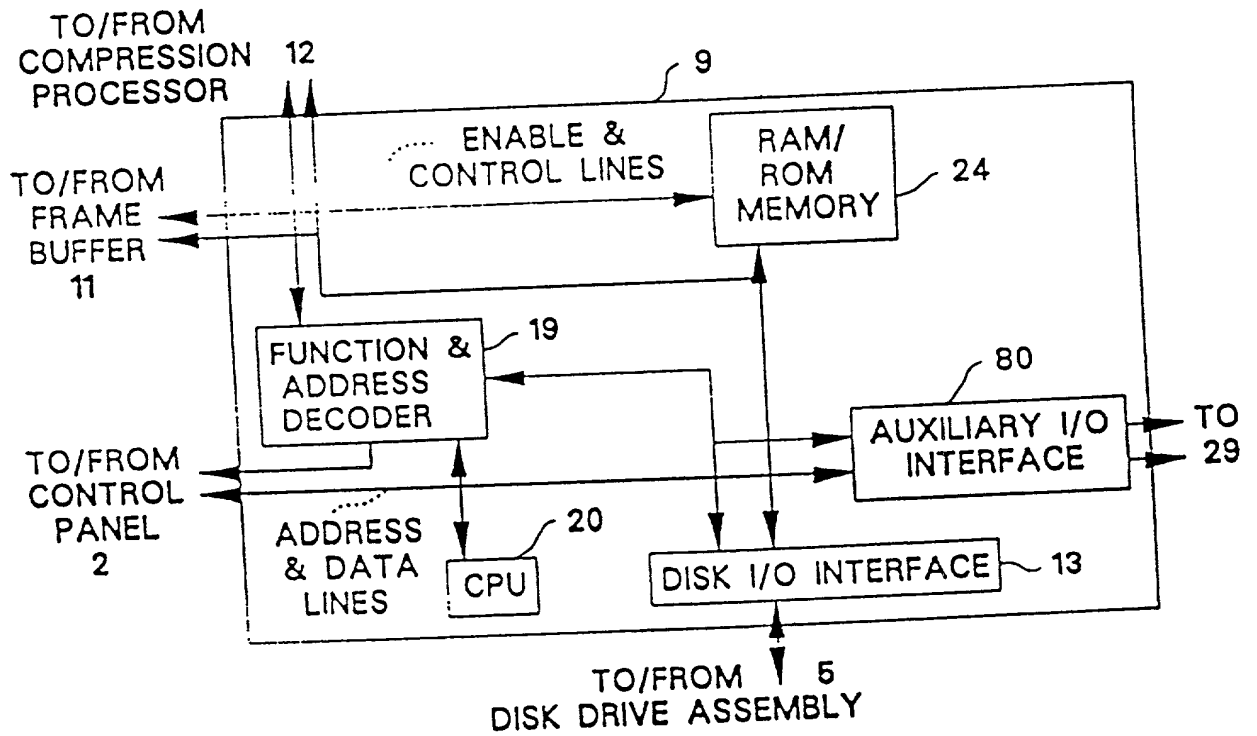


FIG. 7

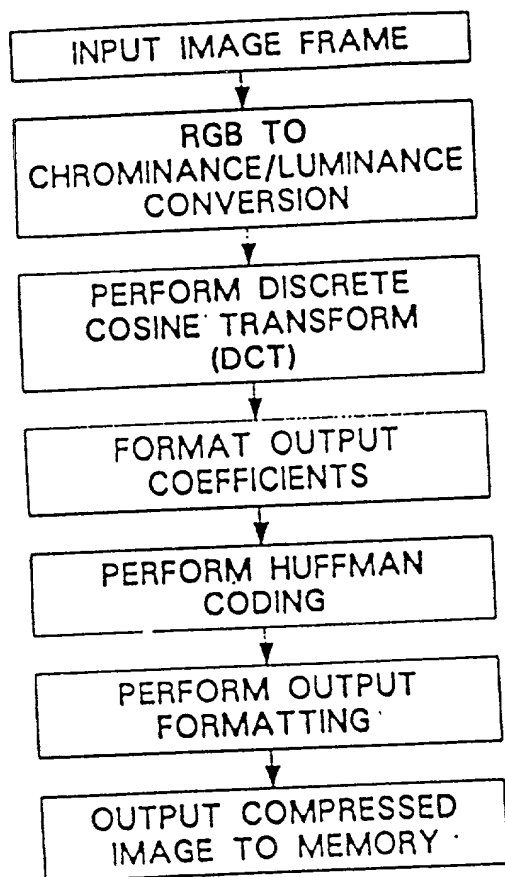


FIG. 8

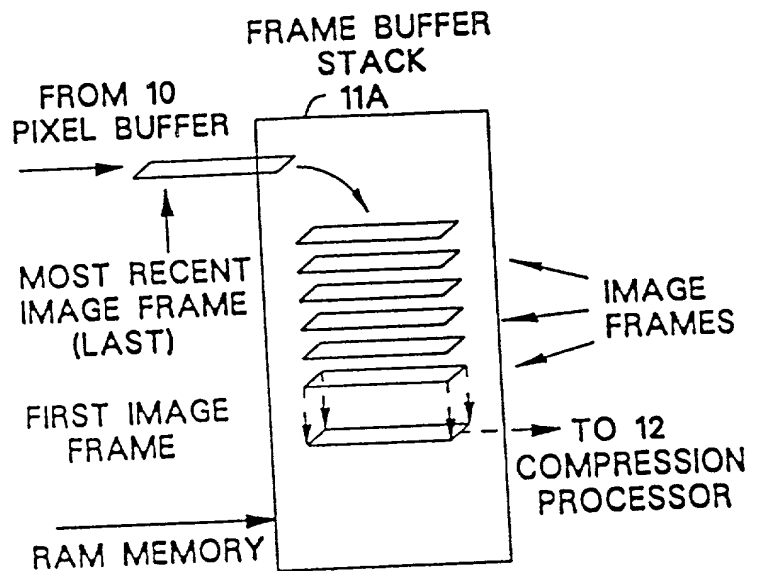


FIG. 13

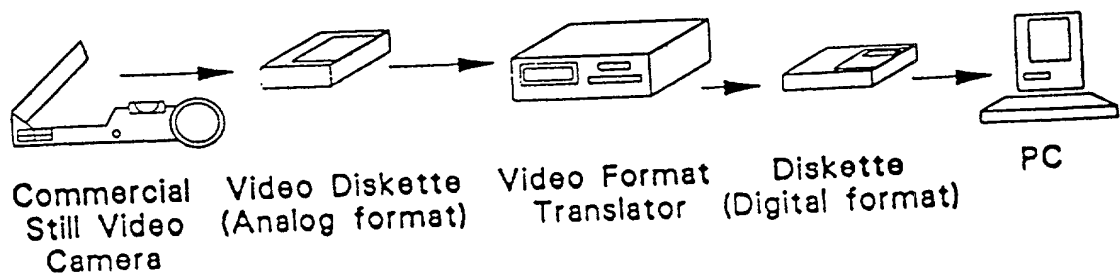


FIG. 10

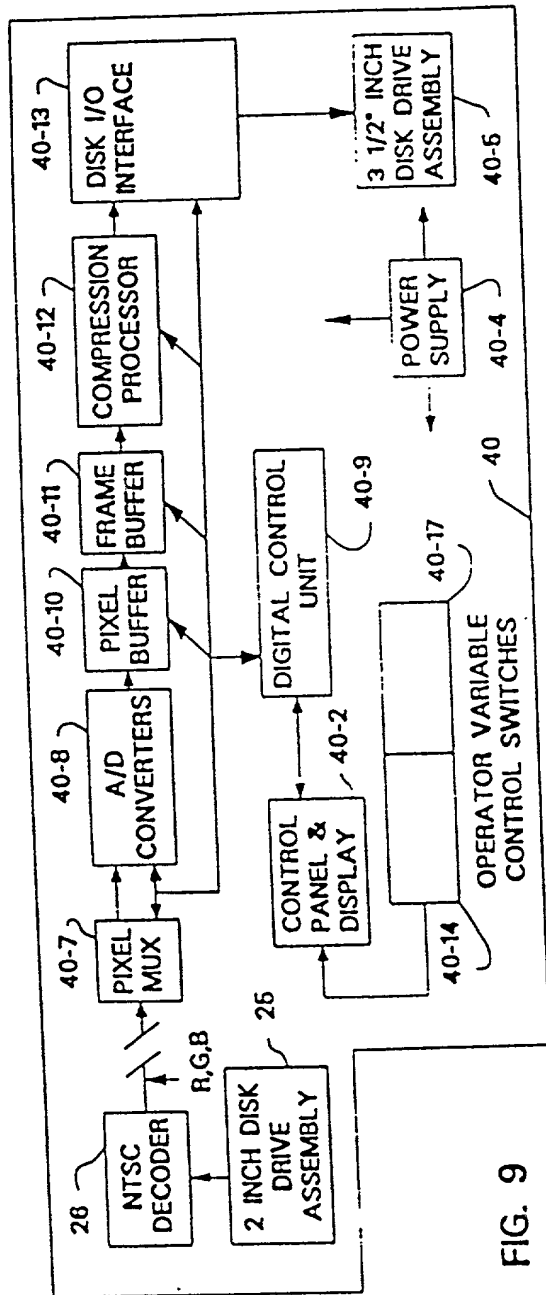


FIG. 9

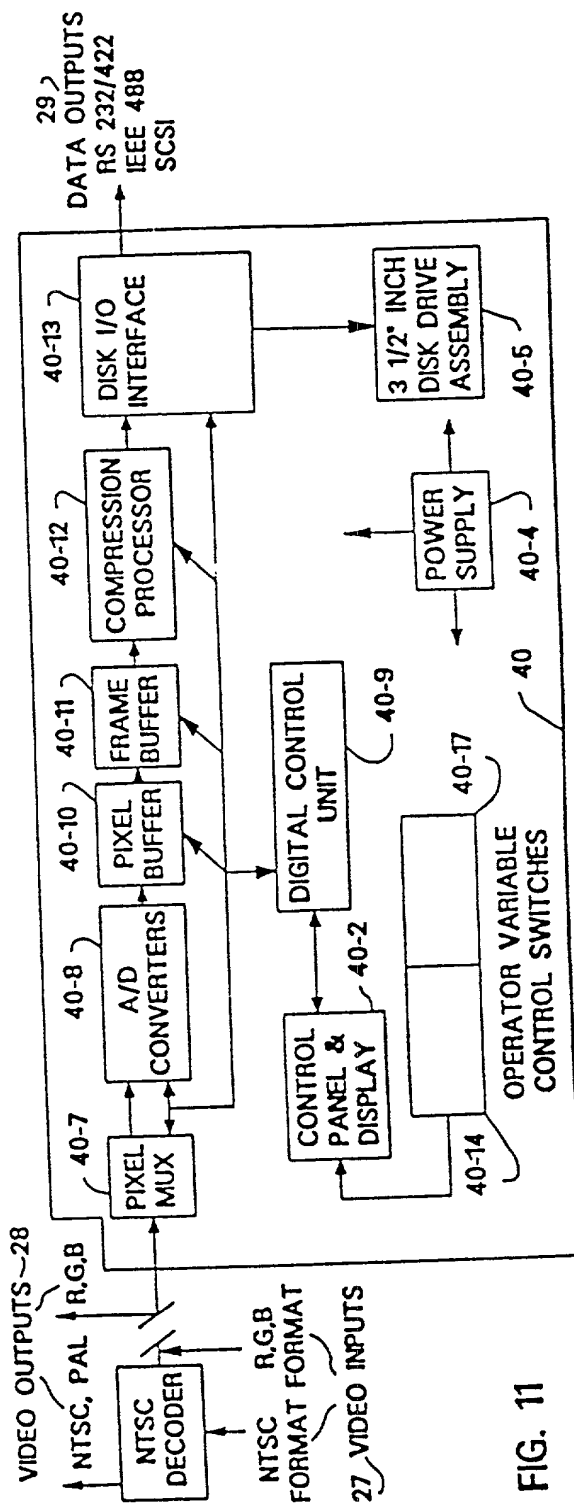
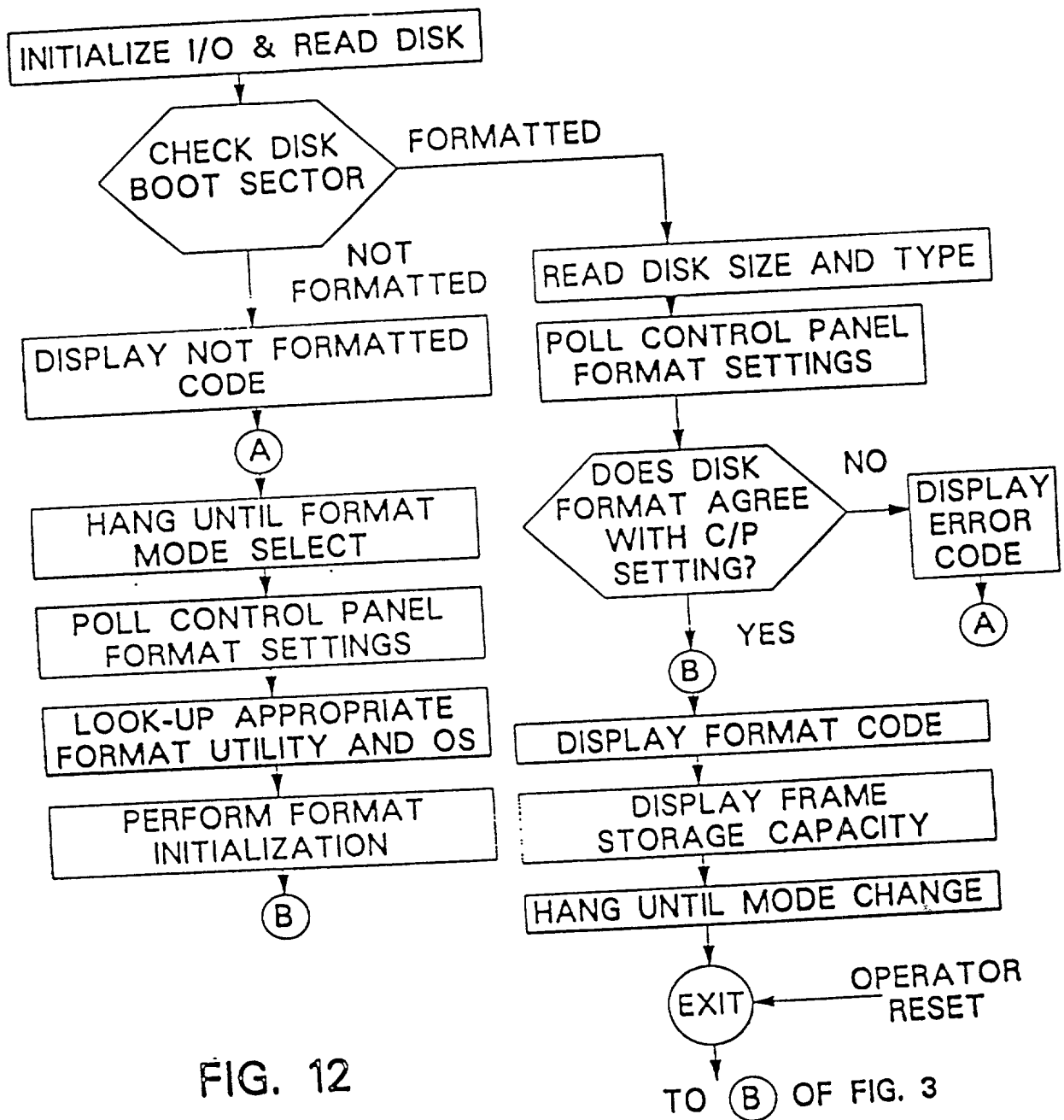


FIG. 11



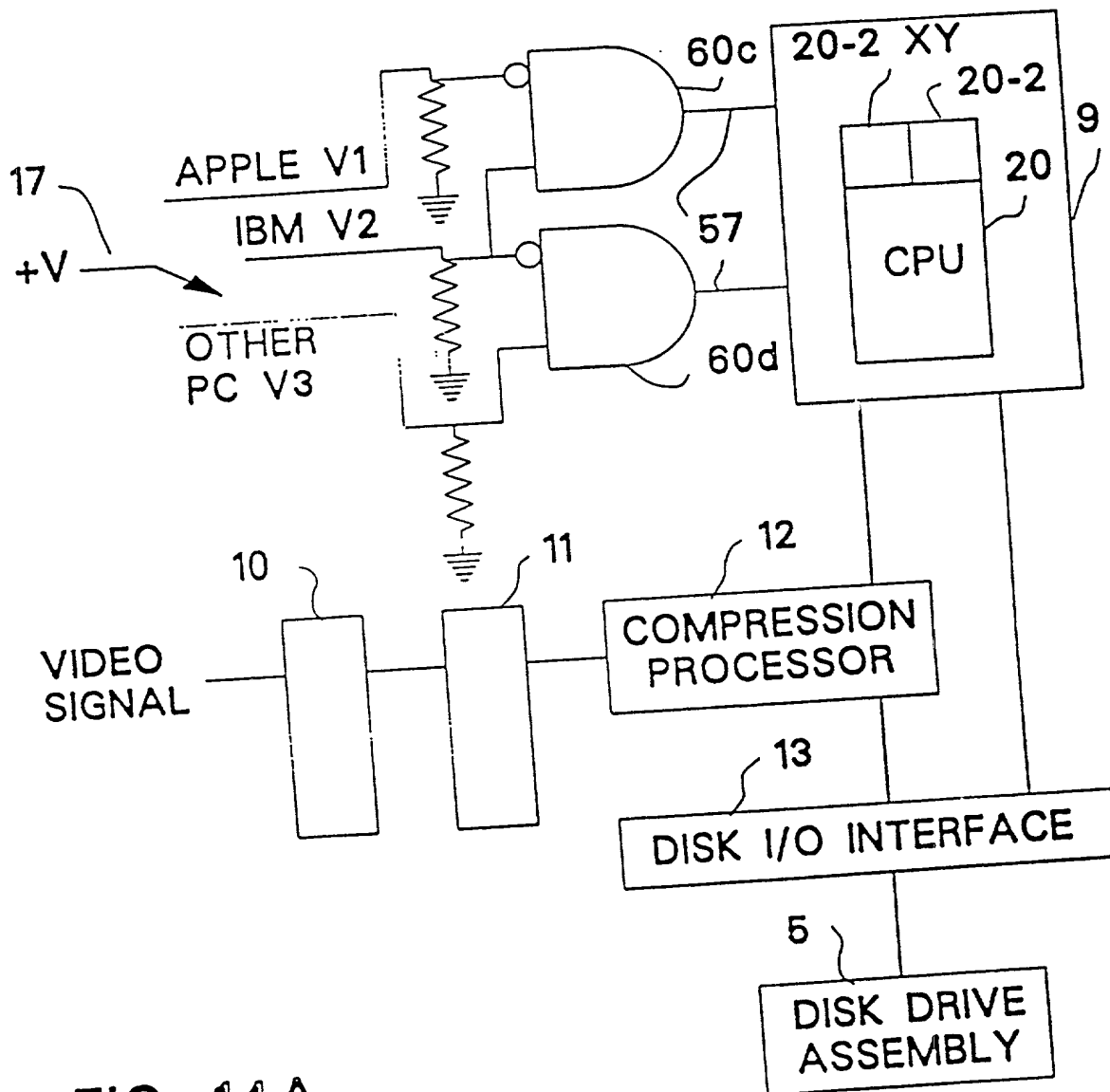


FIG. 14A

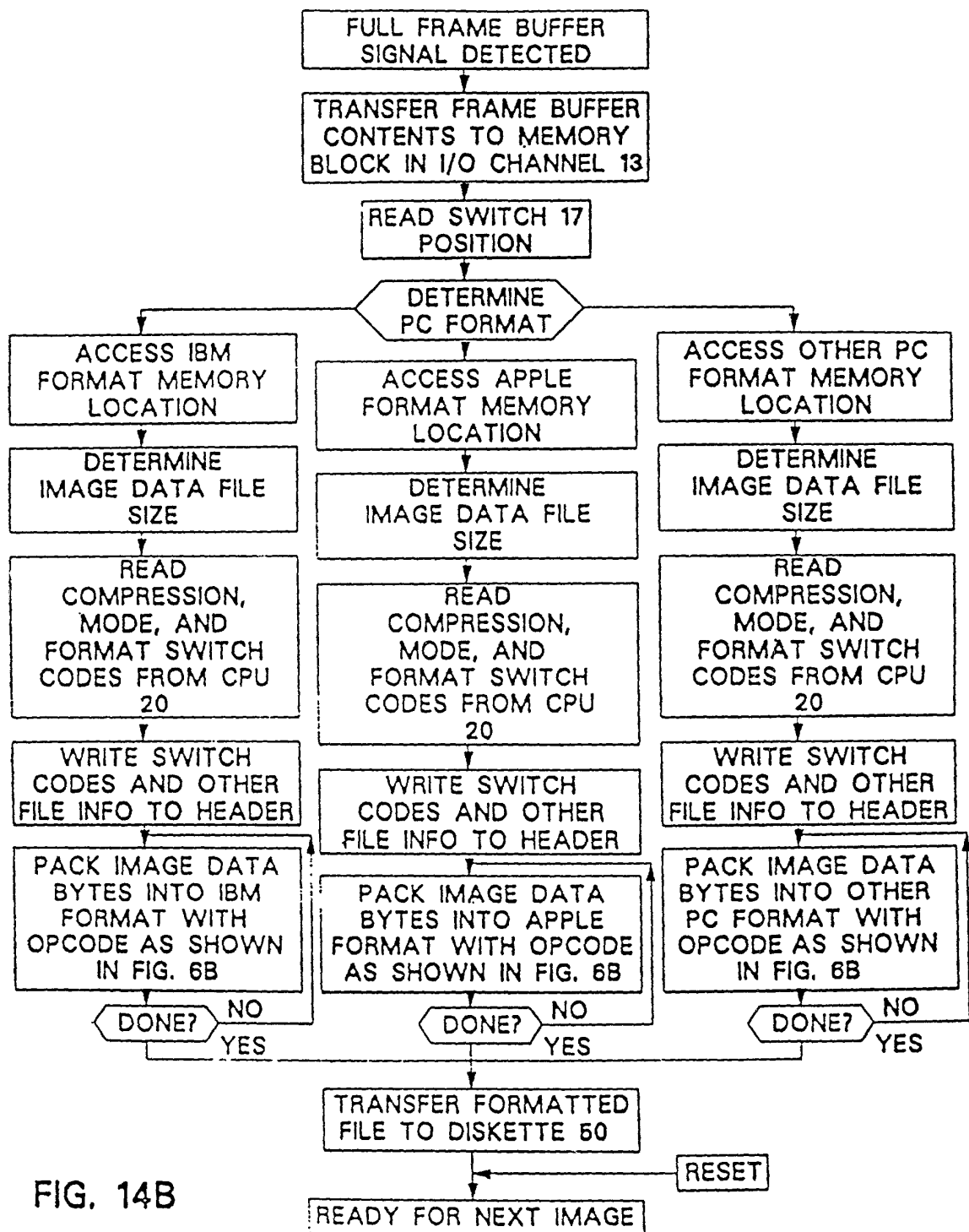


FIG. 14B

PATENT

Attorney's Docket No. 101

COMBINED DECLARATION AND POWER OF ATTORNEY

**(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL,
CONTINUATION OR CIP)**

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: (check one applicable item below)

- ☒ original
☐ design

NOTE: If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application do not check any of next two items and check appropriate one of last three items.

- ☐ national stage of PCT
☐ supplemental

NOTE: If one of the following 3 items apply then complete and also attach **ADDED PAGES FOR DIVISIONAL, CONTINUATION OR CIP.**

- ☐ divisional
☐ continuation
☐ continuation-in-part (CIP)

INVENTORSHIP IDENTIFICATION

WARNING: If the inventors are each not the inventors of all the claims an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.

My residence, post office address and citizenship are as stated below next to my name. I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

ELECTRONIC STILL VIDEO CAMERA WITH DIRECT PERSONAL COMPUTER(PC)
COMPATIBLE DIGITAL FORMAT OUTPUT

SPECIFICATION IDENTIFICATION

the specification of which: (complete (a), (b) or (c))

- (a) ☒ is attached hereto.
(b) ☐ was filed on _____ as ☐ Serial No. _____
or ☐ Express Mail No., as Serial No. not yet known _____
and was amended on _____ (if applicable).

NOTE: Amendments filed after the original papers are deposited with the PTO which contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.

(Declaration and Power of Attorney [1-1]—page 1 of 4)

- (c) ☐ was described and claimed in PCT International Application No. _____ filed on _____ and as amended under PCT Article 19 on _____ (if any).

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

- ☐ In compliance with this duty there is attached an information disclosure statement 37 CFR 1.97.

TO BE FILED LATER

PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

- (d) ☐ no such applications have been filed.
(e) ☐ such applications have been filed as follows

NOTE: Where item (c) is entered above and the International Application which designated the U.S. claimed priority check item (e), enter the details below and make the priority claim.

**EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION**

COUNTRY	APPLICATION NUMBER	DATE OF FILING (month, day, year)	PRIORITY CLAIMED UNDER 37 USC 119
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO

**ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION**

POWER OF ATTORNEY

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration number)

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REG # 22435 201

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(Name and telephone number)

PAUL W. FISH
202 363-6263

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)

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ADDED PAGE TO COMBINED DECLARATION AND POWER OF ATTORNEY
FOR SIGNATURE BY THIRD AND SUBSEQUENT INVENTORS

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Full name of fourth joint inventor, if any _____
Inventor's signature _____
Date _____ Country of Citizenship _____
Residence _____
Post Office Address _____

Full name of fifth joint inventor, if any _____
Inventor's signature _____
Date _____ Country of Citizenship _____
Residence _____
Post Office Address _____